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(71) Applicant: MITSUBISHI JUKOGYO KABUSHIKI KAISHA
5-1, Marunouchi 2-chome Chiyoda-ku
Tokyo(JP)

(72) Inventor: Nagano, Akihito c/o Mihara Machinery Works
Mitsubishi Jukogyo K.K. 5007, Itozaki-cho
Mihara-shi Hiroshima-ken(JP)
Inventor: Masuda, Hiromu c/o Mihara Machinery Works
Mitsubishi Jukogyo K.K. 5007, Itozaki-cho
Mihara-shi Hiroshima-ken(JP)
Inventor: Iwata, Hiroshi Hiroshima Tech. Inst. Mitsubishi
Jukogyo K.K. 6-22, Kannonshin-machi 4-chome
Nishi-ku Hiroshima-shi Hiroshima-ken(JP)

(74) Representative: Henkel, Feiler, Hänzel & Partner
Möhlstrasse 37
D-8000 München 80(DE)

(54) Paper machine twin-wire former.

(57) A paper machine twin-wire former of the type that paper stock jetted from a head-box is immediately pinched between the first and the second dewatering wires respectively forming loops, and formation of a wet paper sheet is performed between these dewatering wires, is improved. The improvements reside in that a stationary shoe is disposed within the loop of the first wire as supporting the first wire for performing dewatering to the side of the second wire and suppresses a dewatering effect to the side of th first wire. A dewatering instrument is disposed within the loop of the second wire as opposed to the loop of the first wire and as supporting the second wire, and performs a suction dewatering effect to the side of the second wire.

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PAPER MACHINE TWIN-WIRE FORMER

BACKGROUND OF THE INVENTION:

Field of the Invention:

The present invention relates to a paper machine twin-wire former for performing formation of a wet paper sheet between two wires. Description of the Prior Art:

In a twin-wire former, two wires respectively form loops, and while they are traveling with stock pinched therebetween, moisture is removed from the stock by means of various dewatering instruments, hence gradually a fiber mat grows and a web is formed. The twin-wire former is characterized in that by eliminating a free surface of stock which was present in the paper machine in the prior art, speed-up of a paper machine has been made possible.

Now, description will be made on a twin-wire former having a dewatering device of shoe type, which is one type of the twin-wire formers in the prior art, with reference to Fig. 7.

Stock 1 jetted upwards from a head-box 5 is pinched between two wires consisting of a top wire 3 and a bottom wire 4 which are guided by a forming roll 6 and a breast roll 7, respectively, and it travels along an approximate curved line R on a plurality of shoe blades 2 spaced from one another on the side of the bottom wire 4 which blades are disposed on a curve having a certain radius of curvature R.

The stock 1 is subjected to dewatering at an equal rate almost simultaneously on the both surfaces due to the collision energy generated when the stock 1 has collided against the wire 3 and 4, a squeezing effect caused by wire tensions when the stock is pinched between the converging wires 3 and 4, pressure pulses generated by a scraping action of the shoe blades 2 and centrifugal forces, thus a fiber mat grows gradually, and a web is formed successively.

Subsequently, at suction boxes 10 and at a suction couch roll 11, dewatering by vacuum is effected and a wet/dry boundary line is formed. On the suction couch roll 11, the web is transferred onto the bottom wire 4, then it is picked up by a suction pick up roll, and it is conveyed to the next press part.

A water deflector 8 and a vacuum deflector 9 are held in contact with the top wire 3, and they are devices for removing water discharged from the top wire 3.

The abov -described twin-wire former of shoe type performs initial wet paper sheet formation by making use of pulse-shaped pressure generated by shoe blades provided intermittently as spaced from one another. In this system, while the amount of movement of fibers is large and hence distribution of texture of paper is improved, a yield is poor due to the fact that dewatering is effected simultaneously at an equal rate to the both sides, also a portion where inter-fiber coupling is little (gap clearance) is formed at the central part of the paper thickness of the finally formed mat, and so, there was a shortcoming that a mechanical strength in the direction of paper thickness (hereinafter called "inter-layer strength") is low as compared to a system in which dewatering is effected only to one side.

In order to resolve these problems, at present a former in which a Fourdrinier portion is provided before the stock is pinched between two wires, about 60 - 70% (though different depending upon a paper making condition) of the amount of water jetted from a head-box is dewatered to the under and in the subsequent twin-wire section dewatering is effected to the both sides, that is, the so-called hybrid type of former has been developed, and it is at the zenith of its prosperity.

Inspecting a cross-section structure of a paper sheet made by this hybrid type of former, the portions where contact points between fibers are few (gap clearances) are few as compared to the case of the twin-wire former, and moreover, the portion having a maximum clearance is present at the location close to the paper sheet surface rather than at the central part of the paper thickness. Accordingly, a coupling strength of fibers in the direction of paper thickness is large. In addition, since the rise of a density of paper caused by a press succeeding to the former is more effective as the location is closer to the paper sheet surface, the gap clearances close to the surface have the advantage that the press effect is big.

As a result, in the case of the hybrid type of former, an inter-layer strength becomes large as compared to the twin-wire former. However, since this hybrid type of former is provided with a Fourdrinier portion for the purpose of resolving the problems, it involves the same shortcomings as those of the Fourdrinier paper making machine, that is, it involves the problems of:

(1) Upon high-speed operation, excessive jumping of stock would arise;

(2) Distribution of texture is poor; and

(3) Profile in the widthwise direction is bad; and so, taking the future developments towards a high speed and high quality into consideration, it is considered that a true twin-wire former in which a

stock jet jetted from a head-box is immediately pinched betwe n two wires is necessary.

SUMMARY OF THE INVENTION:

It is therefore one object of the present invention to provide a twin-wire former which can give an inter-layer strength that is equivalent to that given by a Fourdrinier paper making machine which is known to give a high inter-layer strength.

According to one feature of the present invention, there is provided a paper machine twin-wire former, in which paper stock jetted from a head-box is immediately pinched between two dewatering wires respectively forming loops and formation of a wet paper sheet is performed between the wires, and which former comprises a stationary shoes disposed within the loop of a first wire, supporting the first wire and suppressing dewatering to the side of the first wire, and a dewatering instrument disposed within a second wire loop opposed to the loop of the first wire, supporting the second wire and performing suction dewatering to the side of the second wire.

Regarding the dewatering by a twin-wire former, in the process of forming a wet paper sheet up to the formation of a wet/dry boundary line if a dewatering ratio (a ratio of a removed water to a flow rate of stock jetted from a head-box) to one side exceeds 70%, an inter-layer strength would be also improved in proportion to increase of the dewatering ratio, and if the dewatering ratio becomes about 90% or more, an inter-layer strength at almost the same level as a perfectly one-side dewatered paper sheet such as made by the Fourdrinier type wire former, can be obtained.

According to the present invention, since within the loop of the first wire is disposed a stationary shoe supporting the first wire and suppressing dewatering to the side of the first wire, dewatering in an early period is effected only to the side of the loop of the second wire opposed to the loop of the first wire. In addition, in succession to the same shoe, suction dewatering to the side of the loop of the second wire is effected by a dewatering instrument disposed within the loop of the second wire. Thereby, despite of being a twin-wire type, dewatering is effected as one-side dewatering (assymmetric), thus one-side dewatering is effected up to the dewatering ratio at which the above-mentioned int r-layer strength is improved, and thereby a strength in the thicknesswis dir ction is improved.

Here, it is preferable that the above-describ d dewat ring by means of a stationary shoe is effected up to a mat concentration of about 2 - 3%, and thereafter dewatering is eff cted on the same side as the dewatering by the stationary shoe, by a suction dewatering action of a dewatering instrument against a filtering resistance of a formed mat to form a dry/wet boundary line.

The above-mentioned and other objects, features and advantages of the present invention will become more apparent by reference to the following description of preferred embodiments of the invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS:

In the accompanying drawings:

Fig. 1 is a general schematic view of a first preferred embodiment of the present invention;

Figs. 2 to 5 are schematic views respectively showing different types of dewatering suppression shoes which are available in the preferred embodiment shown in Fig. 1;

Fig. 6 is a general schematic view of a second preferred embodiment of the present invention; and

Fig. 7 is a general schematic view of a twin-wire former in the prior art.

DESCRIPTION OF THE PREFERRED EMBODIMENT:

Now, a first preferred embodiment of the present invention will be described with reference to Figs. 1 to 5.

This preferred embodiment comprises a top wire 3 and a bottom wire 4 respectively forming loops, and stock is jetted from a head-box 5 to between a breast roll 7 for guiding the top wire 3 and a homing roll 6 for guiding the bottom wire 4, and this stock is adapted to be pinched by the both wires 3 and 4.

A dewatering suppression shoe 4 is dispos d within the loop of the top wire 3 contiguously to the breast roll 7. As shown in Fig. 2, this shoe 40 is composed of a plurality of serrated shoe members 40′ each having a land portion 40′a for supporting the wire and an inclined portion 40′b which forms a wedge-shaped hollow space between the wire surface and its surface on the wire inlet side of each land portion 40a.

In succession to the above-described dewatering suppression sho 40, within the loop of the bottom wire 4, two suction box s 10, a first vacuum roll 11 and a transf r box 50 are provided sequentially on the downstream side of the preceding members, and further, on the downstream side of the transfer box 50 is provided a second vacuum roll 30.

On the other hand, at a middle position between the aforementioned transfer box 50 and the second vacuum roll 30 is provided a return roll 60 for the top wire 3, and in addition, on the downstream side of the second vacuum roll 30 is provided a suction pick-up roll 12 for sucking a wet paper sheet. Reference numeral 70 designates a save-all disposed within the loop of the bottom wire 4 at the position of the above-described dewatering suction shoe 40. The side of the top wire 3 of the above-described portion of the suction box 10, the first vacuum roll 11 and the transfer box 50, is exposed to the atmosphere.

In the illustrated embodiment, paper stock jetted from a head-box 5 for feeding the paper stock is immediately pinched between two wires, that is, the top wire 3 and the bottom wire 4, and when the paper stock passes the land portion 40'a of the shoe member 40' in the dewatering suppression shoe 40, due to a reaction force of the wire tension, a pressure is exerted upon the stock between the two wires, and water is squeezed out to the both sides of the two wires. Among the squeezed water, white water once coming out to the side of the top wire 3 where the dewatering suppression shoe 40 is disposed would travel jointly with the wire, and then it is pushed back towards the stock by the wedge action of the wedge-shaped hollow space formed between the inclined surface 40'b of the shoe member 40' in the same shoe 40 and the wire surface. As a result, dewatering to the side of the top wire 3 is suppressed.

On the other hand, on the side of the bottom wire 4 opposed to the top wire 3, since there is nothing to suppress dewatering, dewatering is effected freely by a wire tension and by a pulse-shaped pressure generated when the above-described white water once coming out to the side of the top wire 3 enters into the wedge-shaped hollow space.

By repeating these actions a number of times, mat is successively formed from the side of the bottom wire 4. The removed water is collected in the save-all 70 and then exhausted to the outside of the system.

Furthermore, on the downstream side are disposed suction boxes 10 and a first vacuum roll 11, and by means of these suction boxes 10 and first vacuum roll 11, most of the water contained in the stock is removed to the side of the bottom wire 4. In addition, at this time, by a centrifugal force on the rotating vacuum roll a part of dewatering is effected to the side of the top wire 3, and thereby a wet/dry boundary line is formed.

It is to be noted that in view of improvements in a profile in the widthwise direction, at the jet landing location it is desirable to effect dewatering partly to the side of the top wire 3 by making use of the breast roll 7, and in this case while centrifugal dewatering to the side of the top wire caused by the above-mentioned roll would also arise. However, in the illustrated embodiment it is possible to perform one-side dewatering up to about 95% until formation of the wet/dry boundary line, so that a high inter-layer strength can be obtained as described above. Thereafter, dewatering is further effected to the side of the bottom wire by means of the transfer box 50 and the second vacuum roll 30, a web having a mat concentration raised up to 18 - 20% is formed, and the web leaves the bottom wire 4 as sucked by the suction pick-up roll 12 and is conveyed to a press part in the next step of the process. Normally, as a paper making speed, a mass per unit area and a stock concentration are different depending upon the paper sheet to be made, it is desirable to change the arrangement of the dewatering instruments in the former depending upon these paper making conditions. To that end, in the case of the illustrated embodiment, the serrated shoe member 40' of the dewatering suppression shoe 40 is preferably an extractible blade type member, and in this case as the dewatering ratio can be changes over the range of 50 - 95% by extracting and inserting the shoe member 40', paper sheet qualities such as an inter-layer strength, two-facedness, etc. would become controllable. In addition, since the pressure generated by the configuration, a pitch, etc. of a shoe, is different depending upon a stock concentration, a paper making speed, and so on, it is possible to control the pressure by arraying a plurality of serrated shoe members 40' of different configurations along the direction of flow of the machine.

Furthermore, in the illustrated embodiment, as a dewatering suppression shoe, in place of the shoe illustrated in Fig. 2, modified shoes shown in Figs. 3, 4 and 5 can be employed.

Fig. 3 shows a serrated shoe member 140 not having land portions, and Fig. 4 shows a smooth shoe 240 having a given curvature. In the case of the shoe shown in Fig. 4, though the radius of curvature R could be constant, it is more desirable to make the radius of curvature successively smaller as the location shifts towards the downstream. In addition, Fig. 5 shows a shoe 340 having a plurality of circular-arc-shaped protrusions.

As described above, the illustrated embodiment of the present invention can present the following advantages owing to the combination of the dewatering suppression shoe 40 in the initial dewatering section and th succeeding suction dewatering instruments consisting of the suction boxes 10, the first vacuum roll 11 and the like:

(1) D spite of being a twin-wire former, a one-side dewatering ratio can be raised up to about 95%, and thereby an inter-layer strength can be

improved to the same level as that in the case of a Fourdrinier paper machine;

(2) Since fibers are appropriately redispersed by pressure pulses generated when the removed white water enters into the wedge-shaped hollow spaces as a result of employment of the serrated shoe members 40', texture distribution at the same level as that provided by the double-faced dewatering twin-wire former in the prior art, can be obtained; and

(3) Since stock is pinched between two wires before a jet of stock jetted from a head-box becomes turbulent, high-speed operation is possible.

Owing to the above-mentioned advantages, it becomes possible to make a paper sheet having a good texture distribution and a high inter-layer strength at a high speed.

A second preferred embodiment of the present invention is shown in Fig. 6.

This modified embodiment is basically composed by arraying the first preferred embodiment on an existing Fourdrinier paper making machine, and so, component parts identical to those of the first preferred embodiment are given like reference numerals. In addition, in this preferred embodiment as shown in the figure, a berm deflector 9 is provided on the downstream side of the first vacuum roll 11 to control a dewatering ratio, and within the loop of the bottom wire 4 are additionally provided suction box 55.

In this modified embodiment also, effects and advantages similar to those of the first preferred embodiment can be realized.

As described in detail above, according to the present invention, by performing dewatering to one side in a twin-wire former, an inter-layer strength of a produced paper sheet can be raised up to the same level as that obtained by a Fourdrinier paper machine despite of being a twin-wire former.

In addition, since paper stock is immediately pinched between two wires before a jet from a head-box becomes turbulent, high-speed operation of the machine can be achieved.

While a principle of the present invention has been described above in connection to preferred embodiments of the invention, it is intended that all matter contained in the specification and illustrated in the accompanying drawings shall be interpreted to be illustrative and not as a limitation to the scope of the invention.

Claims

1. A paper machine twin-wire former, in which paper stock jetted from a head-box is immediately pinched between two d watering wires respectiv ly forming loops, and formation of a w t paper sheet is performed between the wires; characterized in that there are provided a stationary shoe disposed within the loop of a first wire, supporting said first wire and suppressing dewatering to the side of said first wire; and a dewatering instrument disposed within a second wire loop opposed to the loop of the first wire, supporting the second wire and performing suction dewatering to the side of said second wire.

2. A paper machine twin-wire former as claimed in Claim 1; characterized in that the twin-wire is disposed in a Fourdrinier paper machine.

3. A paper machine twin-wire former as claimed in Claim 1 or 2; characterized in that the stationary shoe disposed within the first wire loop for suppressing dewatering, is composed of a plurality of serrated shoe members forming wedge-shaped hollow spaces.

4. A paper machine twin-wire former as claimed in Claim 3; characterized in that each of said plurality of serrated shoe members is extractible and insertable.

5. A paper machine twin-wire former as claimed in Claim 1 or 2; characterized in that the stationary shoe disposed within the first wire loop for suppressing dewatering, is a shoe provided with a plurality of serrations.

6. A paper machine twin-wire former as claimed in Claim 1 or 2; characterized in that the stationary shoe disposed within the first wire loop for suppressing dewatering, is a shoe having a curvature.

7. A paper machine twin-wire former as claimed in Claim 1 or 2; characterized in that the stationary shoe disposed within the first wire loop for suppressing dewatering, is a shoes having a plurality of circular-arcshaped protrusions.

Fig. 1

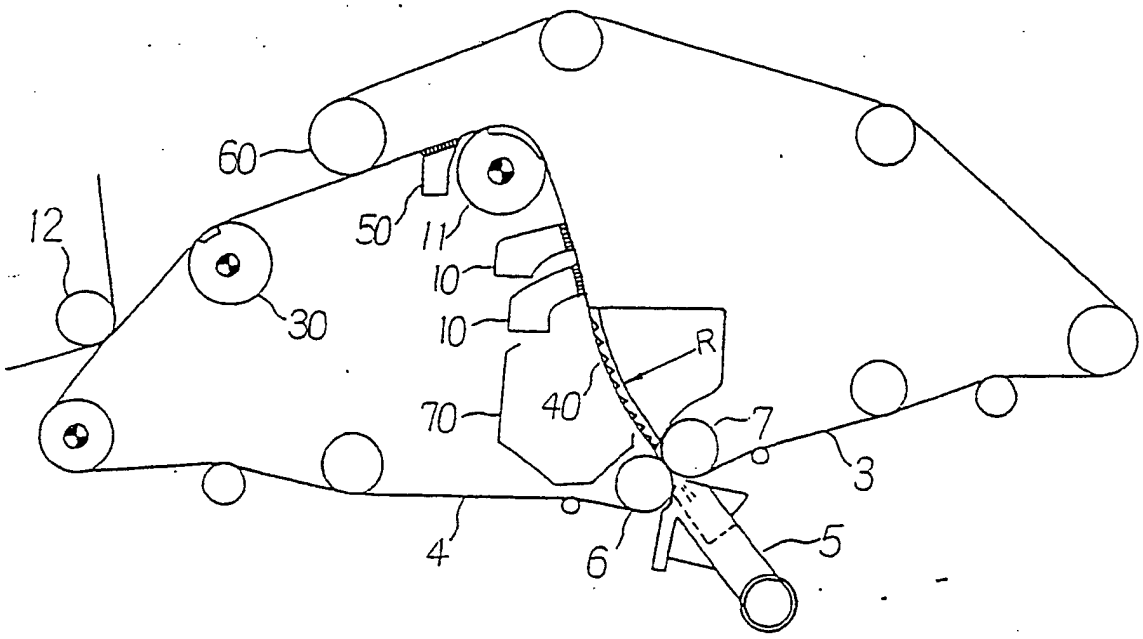


Fig. 2

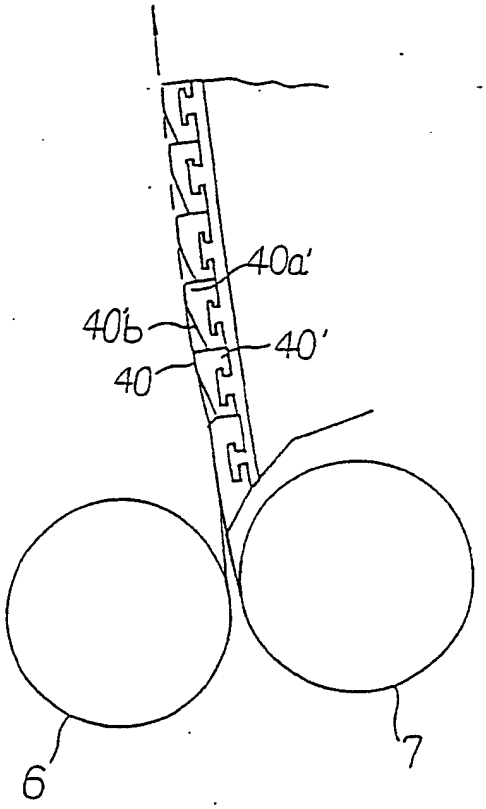


Fig. 3

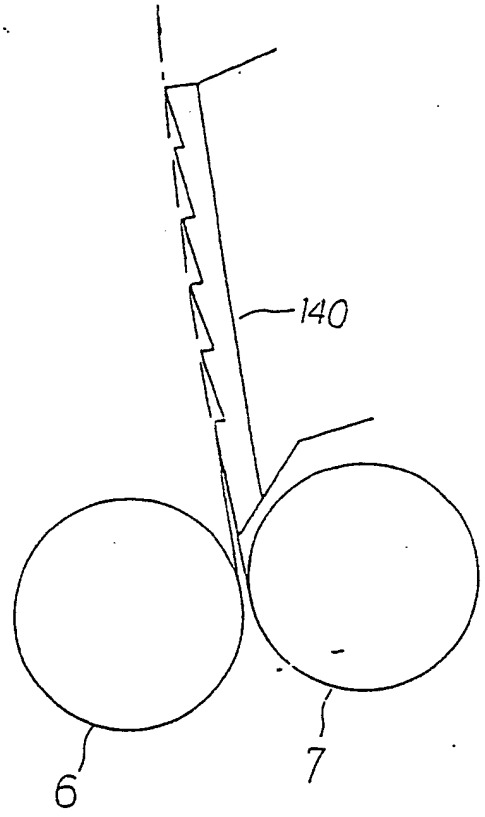


Fig. 4

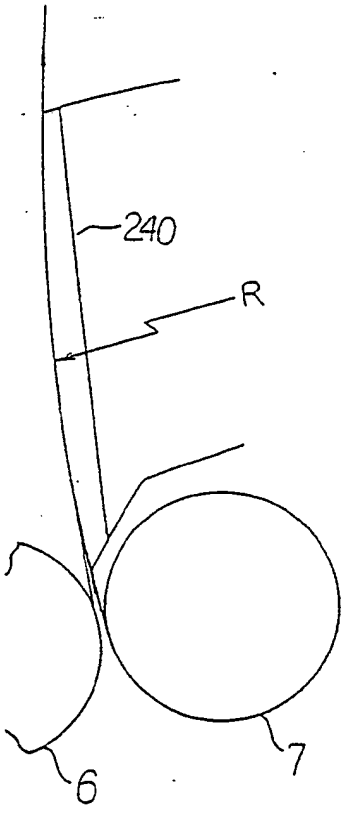


Fig. 5

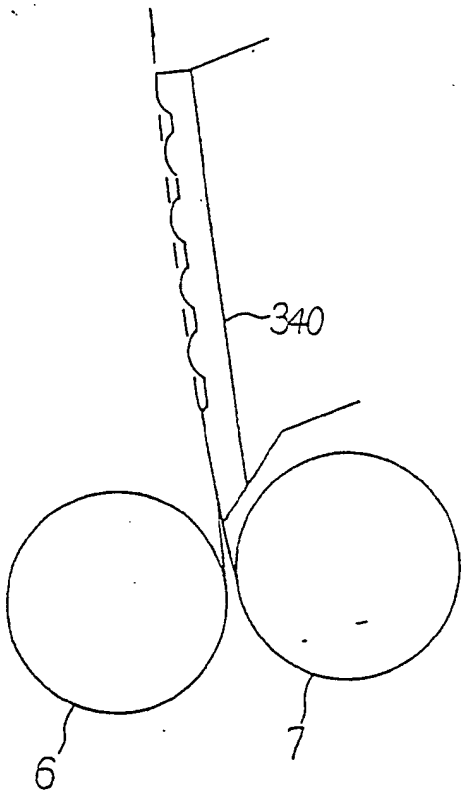


Fig. 6

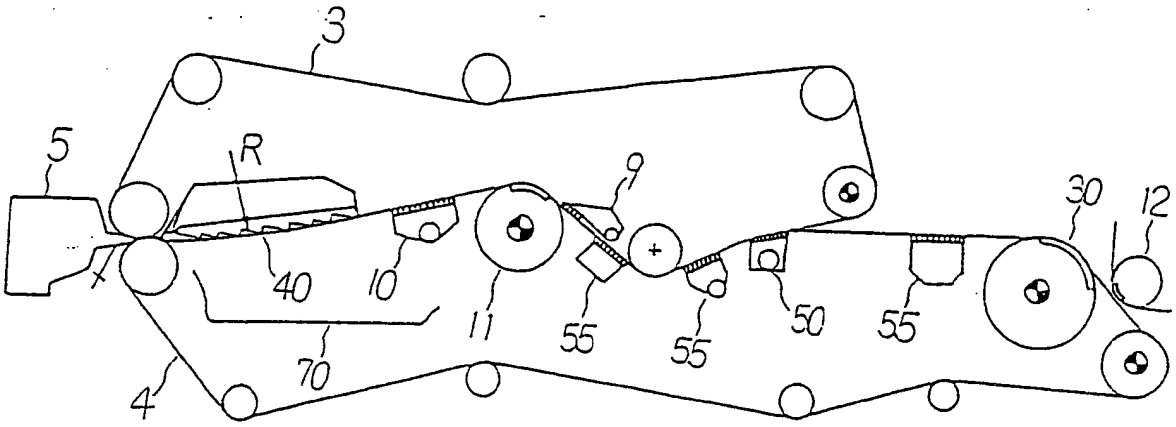
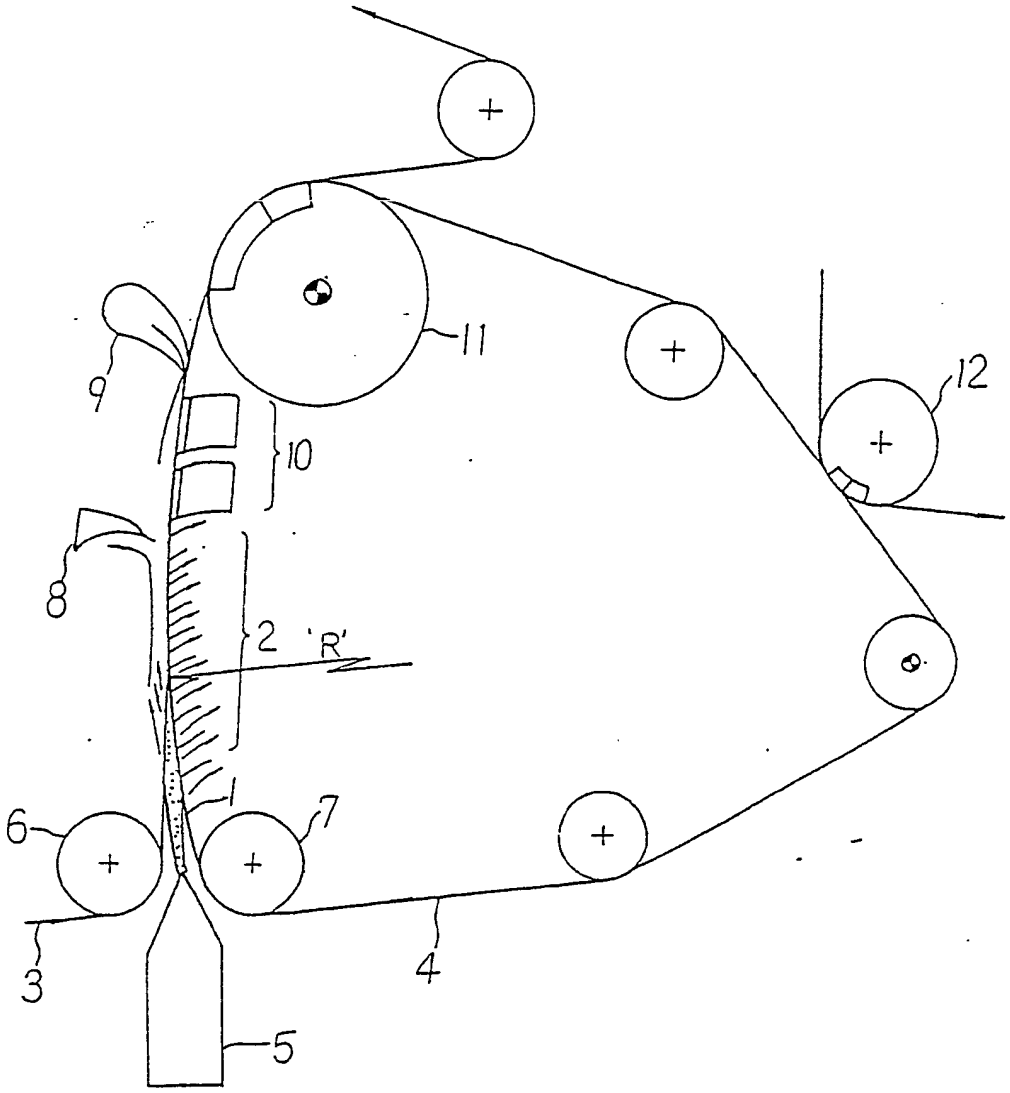


Fig. 7 (Prior Art)



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(71) Applicant: MITSUBISHI JUKOGYO KABUSHIKI KAISHA
5-1, Marunouchi 2-chome Chiyoda-ku
Tokyo(JP)

(72) Inventor: Nagano, Akihito c/o Mihara Machinery Works
Mitsubishi Jukogyo K.K. 5007, Itozaki-cho
Mihara-shi Hiroshima-ken(JP)
Inventor: Masuda, Hiromu c/o Mihara Machinery Works
Mitsubishi Jukogyo K.K. 5007, Itozaki-cho
Mihara-shi Hiroshima-ken(JP)
Inventor: Iwata, Hiroshi Hiroshima Tech. Inst. Mitsubishi
Jukogyo K.K. 6-22, Kannonshin-machi 4-chome
Nishi-ku Hiroshima-shi Hiroshima-ken(JP)

(74) Representative: Henkel, Feiler, Hänzel & Partner
Möhlstrasse 37
W-8000 München 80(DE)

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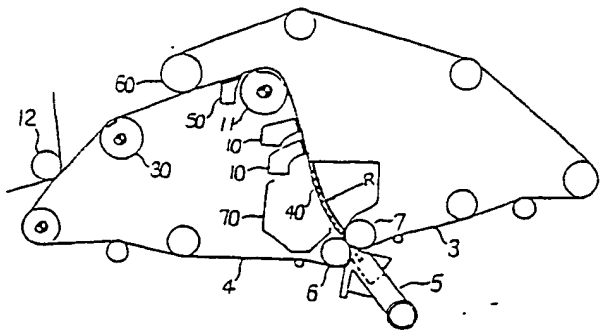
Fig. 1



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European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 12 0612

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-2 977 277 (KELLY) " the whole document "	1,6	D 21 F 9/00
X	FR-A-2 072 936 (WALMSLEYS) " the whole document "	1,6	
X	US-A-3 855 057 (HILL) " the whole document "	1,6	
A	DE-A-3 329 833 (AHLSTRÖM) " the whole document "	1,6	
A	DE-A-2 531 839 (VALMET OY) " the whole document "	1,2,6	
A	EP-A-0 177 439 (RESEARCH ASSOCIATION OF PULP AND PAPER TECHNOLOGY) " the whole document "	3,5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D 21 F

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	02 October 91	DE RIJCK F.

CATEGORY OF CITED DOCUMENTS

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